* NOTICES *

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the evaporation apparatus which makes a deposition plate vapor-deposit the deposition substance which evaporated within the chamber by which the inside was decompressed with physical vapor deposition (PVD).
[0002]
[Description of the Prior Art]The conventional evaporation apparatus shown in drawing 8 is provided with the crucible 30 which has the deposition substance 100 used as an evaporation source in the chamber 20 by which the inside was decompressed, and the deposition plate 200 held horizontally above the crucible 30. And the deposition substance 100 which was heated with the crucible 30 and evaporated is made to emit in the chamber 20 as it is from the injection hole 30b which carries out an opening to the crucible 30 upper part, and the deposition plate 200 is made to vapor-deposit it.
[0003]And pull apart the deposition plate 200 and the crucible 30 greatly, arrange them, he is trying to spread the deposition substance 100 enough horizontally, and equalization of the vacuum evaporation to the deposition plate 200 is attained. Generally the interval L1 of the deposition plate 200 and the injection hole 30b is made into the length L2 of the deposition plate 200 about 3 times the size of one side.
[0004]
[Problem(s) to be Solved by the Invention]however, the above -- when the interval L1 of the deposition plate 200 and the injection hole 30b was enlarged like a device before, there was a problem of many of deposition substances 100 not adhering to the deposition plate 200, but adhering to the inner surface of the chamber 20. That the inner surface of the chamber 20 must be cleaned especially frequently was reducing working efficiency greatly. Incidentally, when the size of L1 is L3 times 2, the percentage (vacuum evaporation rate) which the deposition substance 100 in the crucible 30 vapor-deposits is about 6%.
[0005]When the interval L1 of the deposition plate 200 and the injection hole 30b was enlarged, the chamber 20 was enlarged, and while the time for making the inside of the chamber 20 into a vacuum became long, there was a problem that the energy expenditure for using a vacuum became large.
[0006]Maintaining the homogeneity of the vacuum evaporation to a deposition plate in view of the point describing above, this invention makes the interval of a deposition plate and an injection hole small, and an object of this invention is to attain the improvement in a vacuum evaporation rate, and the

miniaturization of a chamber.

[0007]

[Means for Solving the Problem]In order to attain the above-mentioned purpose, in the invention according to claim 1. In an evaporation apparatus which makes a deposition plate (200) vapor-deposit a deposition substance (100) with physical vapor deposition within a chamber (20) by which an inside was decompressed, Are open for free passage with an evaporation chamber (30a) which heats a deposition substance (100) and evaporates it, and an evaporation chamber (30a), It has a transfer pipe (60) which transports a deposition substance (100) near the vacuum evaporation side (200a) of a deposition plate (200) from an evaporation chamber (30a), Two or more injection holes (62a) which emit a deposition substance (100) towards a vacuum evaporation side (200a) are formed in a discharge part (62) which is a portion which faces a vacuum evaporation side (200a) among transfer pipes (60).

[0008]A deposition substance (100) which evaporated will be compulsorily transported near the vacuum evaporation side (200a) by a transfer pipe (60) by this, and it will be emitted towards a vacuum evaporation side (200a) after that from two or more injection holes (62a) formed in a position which faces a vacuum evaporation side (200a). Therefore, even if it makes small an interval of a vacuum evaporation side (200a) and an injection hole (62a) compared with a case where it is made to emit in a chamber (20) as it is, from an injection hole (30b) which carries out an opening to the crucible (30) upper part by the conventional evaporation apparatus, the homogeneity of vacuum evaporation to a vacuum evaporation side (200a) can be maintained. Therefore, improvement in a vacuum evaporation rate and a miniaturization of a chamber (20) can be attained, maintaining the homogeneity of vacuum evaporation to a deposition plate (200).

[0009]By the way, a deposition substance (100) which evaporated that a transfer pipe (60) was the low temperature below prescribed temperature adheres to a transfer pipe (60) inner surface easily, and a deposition substance (100) is got clogged with an injection hole (62a) especially easily. On the other hand, in the invention according to claim 2, since it is characterized by having a heating method (70) which heats a transfer pipe (60), adhesion in a transfer pipe (60) inner surface of a deposition substance (100) and blinding of an injection hole (62a) can be controlled.

[0010]In the invention according to claim 3, it has an attachment component (50) holding a deposition plate (200) in a chamber (20), The homogeneity of vacuum evaporation to a vacuum evaporation side (200a) can be improved without enlarging an interval of a vacuum evaporation side (200a) and an injection hole (62a), since either [at least] an attachment component (50) or a discharge part (62) is characterized by a thing movable in parallel to a vacuum evaporation side (200a).

[0011]In the invention according to claim 4, a discharge part (62) of a transfer pipe (60) was formed so that a vacuum evaporation side (200a) might be countered and it might extend in abbreviated parallel. The homogeneity of vacuum evaporation to a vacuum evaporation side (200a) can be improved without enlarging an interval of a vacuum evaporation side (200a) and an injection hole (62a), since a deposition substance (100) which evaporated is transported by this so that it may spread in parallel to a vacuum evaporation side (200a).

[0012]By the way, a pressure of a deposition substance (100) in a downstream part in a discharge part (62), Since it becomes low by discharge from an injection hole (62a) of an upstream section, a burst size of an injection hole (62a) of a downstream part will decrease compared with a burst size of an injection hole (62a) of an upstream section, and the homogeneity of vacuum evaporation to a vacuum evaporation side (200a) will be spoiled by extension. On the other hand, it has an upstream heating method (72)

which heats a downstream heating method (71) and an upstream portion which heat a downstream portion of a transporting direction of a deposition substance (100) among discharge parts (62) in the invention according to claim 5, Regulation of a heating degree by the downstream and an upstream heating method (71, 72) was enabled individually, respectively.

[0013]If a heating degree by a downstream heating method (71) is made by this larger than a heating degree by an upstream heating method (72) and temperature of a deposition substance (100) of the downstream is raised, The failure of pressure of a downstream part in a discharge part (62) can be controlled, and it can control that a burst size of an injection hole (62a) of a downstream part decreases compared with a burst size of an injection hole (62a) of an upstream section.

[0014]In the invention according to claim 6, an injection hole (62a) located in the downstream of a transporting direction of a deposition substance (100) among two or more injection holes (62a), Since it is characterized by forming in a larger effective area product than an injection hole (62a) located in the upstream, it can control that a burst size of an injection hole (62a) of a downstream part decreases compared with a burst size of an injection hole (62a) of an upstream section.

[0015]Since it is characterized by making an interval (P2) of an injection hole (62a) located in the downstream of a transporting direction of a deposition substance (100) narrower than an interval (P3) of an injection hole (62a) located in the upstream in the invention according to claim 7, It can control that a burst size from a downstream part of a discharge part (62) decreases compared with a burst size from an upstream section.

[0016]In the invention according to claim 8, distance (L3) at the lowest flow position injection hole (62a) in which it is located in the style of [of a transporting direction of a deposition substance (100)] the bottom among injection holes (62a), and a tip of a discharge part (62), It is characterized by a long time from distance (P4) of the lowest flow position injection hole (62a) and an injection hole (62a) located next to the lowest flow position injection hole (62a).

[0017]Thereby, between the lowest flow position injection hole (62a) and a tip of a discharge part (62), space (62b) of predetermined length (L3) is formed in in a discharge part (62). Therefore, a pressure pulsation of a deposition substance (100) transported to the lowest flow position injection hole (62a) from the upstream, Since it can absorb with a deposition substance (100) in said space (62b) and said space (62b) functions as what is called a surge tank, release pressure of the lowest flow position injection hole (62a) by said pulsation can control falling temporarily. Therefore, reduction of a temporary burst size of the lowest flow position injection hole (62a) can be controlled.

[0018]In the invention according to claim 9, parallel arrangement of two or more discharge parts (62) was carried out on a field parallel to a vacuum evaporation side (200a). Since an injection hole (62a) can be arranged side by side by this to a 2-way of a direction and a parallel direction of a discharge part (62) where a discharge part (62) is prolonged, a deposition substance (100) can be emitted in two dimensions to a vacuum evaporation side (200a), and the homogeneity of vacuum evaporation to a vacuum evaporation side (200a) can be improved.

[0019]Even if it is a case where a burst size of an injection hole (62a) of a downstream part decreases compared with a burst size of an injection hole (62a) of an upstream section here, If a deposition substance (100) in an adjacent discharge part (62) is transported to direction which counters mutually like the invention according to claim 10, the homogeneity of vacuum evaporation to a vacuum evaporation side (200a) is easily securable.

[0020]Numerals in a parenthesis of each above-mentioned means are examples which show a

correspondence relation with a concrete means of a statement to an embodiment mentioned later.
[0021]
[Embodiment of the Invention](A 1st embodiment) This embodiment shows the case where the evaporation apparatus of this invention is used to the evaporation apparatus which forms the organic metal (deposition substance) which forms a luminous layer among the manufacturing processes of an organic electroluminescence element (it is hereafter called an organic EL device) on a glass substrate (deposition plate). Incidentally, this organic EL device is a well-known organic EL device with which it comes to laminate the 1st electrode layer, a hole injection layer, an electron hole transporting bed, a luminous layer, an electron transport layer, and the 2nd electrode layer on a glass substrate one by one.
[0022]Within the film forming chamber 20 by which drawing 1 is a figure showing the entire configuration of the evaporation apparatus of this embodiment, and the inside was decompressed with the vacuum pump 10 (for example, about 1.33×10^{-4}Pa (about 1×10^{-6}torr)), The glass substrate 200 is made to vapor-deposit the organic metal 100 which evaporated with physical vapor deposition (PVD), and membranes are formed. The film forming chamber 20 divides, it is formed so that assembly demolition can be carried out, and supply work of the organic metal 100 to film forming chamber 20 inside and desorption of the glass substrate 200 are performed by carrying out the division demolition of the film forming chamber 20.
[0023]the organic metal (Alq3 [for example,] (aluminum kino reel).) of the solid which becomes a lower part in the film forming chamber 20 with an evaporation source The crucibles 30 which store 100, such as CuPC (copper phthalocyanine), are arranged, and the sheath heater (heating method) 40 which generates heat by energization is twisted around the peripheral face of the crucible 30. And the evaporation chamber 30a in the crucible 30 is full of the organic metal 100 which was heated by the sheath heater 40 and evaporated. At this embodiment, it heats at about 320 **.
[0024]On the other hand, the upper part in the film forming chamber 20 is equipped with the attachment component (for example, susceptor) 50 which holds the tabular glass substrate 200 horizontally, and this attachment component 50 is attached to the film forming chamber 20 pivotable. And while transporting the organic metal 100 which was open for free passage with the evaporation chamber 30a, and evaporated near the vacuum evaporation side 200a of the glass plate 200 from the evaporation chamber 30a to the upper part of the crucible 30, It has the transfer pipe 60 of the cylindrical shape which emits the organic metal 100 which evaporated in the film forming chamber 20 towards the vacuum evaporation side 200a.
[0025]The transferring part 61 of the elbow shape at which it turns abbreviated 90 degrees after this transfer pipe 60 is prolonged in the upper part from the upper part of the crucible 30, It is formed and comprises the discharge part 62 which transports the organic metal 100 which evaporated so that it may spread in parallel to the vacuum evaporation side 200a so that the vacuum evaporation side 200a may be countered in the lower part of the vacuum evaporation side 200a and it may extend in abbreviated parallel. And two or more injection holes 62a which emit the organic metal 100 which evaporated up are formed in the vacuum evaporation side 200a and the portion which counters among the discharge parts 62.
[0026]In this embodiment, the discharge part 62 is piping shape prolonged to the length L2 almost same to the longitudinal direction of drawing 1 as one side of the glass substrate 200, and the nine injection holes 62a are formed in the longitudinal direction at equal intervals (P1 = about 33 mm) at the single tier. And the aperture shape of the injection hole 62a is a round shape about 0.5 mm in diameter.

[0027]The interval L1 of the glass arrival board 200 and the injection hole 62a, It is set up at least smaller than the length L2 of one side of the glass substrate 200, and in this embodiment. It is set up so that the interval L1 (for example, about 90 mm) of the glass arrival board 200 and the injection hole 62a may become the length L2 (for example, about 200 mm) of the glass substrate 200 about 0.45 time the size of one side.

[0028]The sheath heater (heating method) 70 which generates heat by energization is twisted around the peripheral face of the transfer pipe 60, and the transfer pipe 60 is heated and is kept warm by prescribed temperature (for example, 300 **). This has prevented adhesion in transfer pipe 60 inner surface of the organic metal 100 which evaporated, and blinding of the injection hole 62a.

[0029]Next, the operation of the evaporation apparatus by the above-mentioned composition is explained.

[0030]First, where the division demolition of the film forming chamber 20 is carried out, the glass substrate 200 is attached to the attachment component 50. The organic metal 100 of the solid used as an evaporation source is supplied in the crucible 30. Then, the film forming chamber 20 is assembled and the inside of the film forming chamber 20 is decompressed with the vacuum pump 10. And it energizes to the sheath heater 40, and the organic metal 100 of an individual is heated and is evaporated. The organic metal 100 which evaporated is compulsorily transported near the vacuum evaporation side 200a by the transferring part 61 of the transfer pipe 60, and it is transported so that it may spread in the longitudinal direction of drawing 1 to the vacuum evaporation side 200a by the discharge part 62 after that. And the organic metal 100 which evaporated is emitted in the film forming chamber 20 toward the vacuum evaporation side 200 from two or more injection holes 62a which carry out an opening to the discharge part 62, and is adhered and vapor-deposited to the vacuum evaporation side 200a of the glass substrate 200.

[0031]Thus, since the organic metal 100 which evaporated is emitted from two or more injection holes 62a formed in the position which faces the vacuum evaporation side 200a, Even if it makes the interval L1 of the vacuum evaporation side 200a and the injection hole 62a smaller than the length L2 of one side of the glass substrate 200 (this embodiment L1=0.45xL2), The improvement in a vacuum evaporation rate and the miniaturization of the chamber 20 can be attained being able to maintain the homogeneity of the vacuum evaporation to the vacuum evaporation side 200a, and maintaining the homogeneity of the vacuum evaporation to the glass arrival board 200. Incidentally, in this embodiment, it became clear to the vacuum evaporation rate by the conventional evaporation apparatus being about 6% that a vacuum evaporation rate can be made about 30% by experiment of the applicants of this invention.

[0032]The pressure in the transfer pipe 60 becomes higher than the pressure in the film forming chamber 20 in connection with the organic metal 100 being heated under the conditions of volume regularity. Thereby, the organic metal 100 emitted from the injection hole 62a carries out decompression expansion rapidly, will be in a supercooling state and is clustered. And since the migration of the deposition substance 100 and condensation will take place if the clustered deposition substance 100 adheres to the deposition plate 200, the adhesion to the deposition plate 200 of the deposition substance 100 can be raised.

[0033](A 2nd embodiment) Drawing 2 is a perspective view showing the main part of the transfer pipe 60 and crucible 40 grade among the evaporation apparatus of this embodiment, and the downstream sheath heater (heating method) 71 is twisted around the downstream portion (left part of drawing 2) of

the transporting direction of the organic metal 100 among the discharge parts 62. The upstream sheath heater (heating method) 72 is twisted around the upstream portion (right portion of drawing 2), and the voltage which carries out a seal of approval to the downstream and the upstream sheath heaters 71 and 72 can be individually adjusted now, respectively.

[0034]And it has the downstream thickness monitor 81 which measures the thickness of the organic metal 100 of the portion corresponding to the downstream sheath heater 71 among the glass substrates 200, and the upstream thickness monitor 82 which measures the thickness of the organic metal 100 of the portion corresponding to the upstream sheath heater 72. It has the thermo couple which measures each temperature of the downstream and the upstream sheath heaters 71 and 72 and which is not illustrated.

[0035]And the impressed electromotive force to each sheath heaters 71 and 72 is adjusted so that the temperature reading on the thermometer by a thermo couple may be changed according to the thickness measured by the thickness monitor 81. For example, if the voltage which carries out a seal of approval to the downstream sheath heater 71 will be raised if the thickness of the downstream becomes thin, and the temperature of the organic metal 100 of the downstream is raised, The failure of pressure of the downstream part in the discharge part 62 can be controlled, and it can control that the burst size of the injection hole 62a of a downstream part decreases compared with the burst size of the injection hole 62a of an upstream section.

[0036](A 3rd embodiment) Although all of the effective area product of two or more injection holes 62a are identically formed in a 1st embodiment, According to this embodiment, as shown in drawing 3, the injection hole 62a located in the downstream (left-hand side of drawing 3) of the transporting direction of the organic metal 100 is formed in a larger effective area product than the injection hole 62a located in the upstream (right-hand side of drawing 3). Thereby, it can control that the burst size of the injection hole 62a of a downstream part decreases compared with the burst size of the injection hole 62a of an upstream section.

[0037](A 4th embodiment) At a 1st embodiment, although the interval P1 of two or more injection holes 62a is formed identically altogether, as shown in drawing 4, by this embodiment, the interval P2 of the injection hole 62a located in the downstream of the transporting direction of the organic metal 100 is made narrower than the interval P3 of the injection hole 62a located in the upstream. Thereby, it can control that the burst size from the downstream part of the discharge part 62 decreases compared with the burst size from an upstream section.

[0038](A 5th embodiment) As shown in drawing 5, in this embodiment. The distance L3 at the lowest flow position injection hole 62a in which it is located among the injection holes 62a in the style of [of the transporting direction of the organic metal 100] the bottom (leftmost side of drawing 5), and the tip of the discharge part 62, It is formed so that it may become longer than the distance P4 of the lowest flow position injection hole 62a and the injection hole 62a located next to the lowest flow position injection hole 62a (right-hand side of drawing 5).

[0039]Thereby, between the lowest flow position injection hole 62a and the tip of the discharge part 62, the space 62b of the predetermined length L3 is formed in in the discharge part 62. Therefore, since it can absorb with the organic metal 100 in said space 62b and the space 62b functions as what is called a surge tank, the pressure pulsation of the organic metal 100 transported to the lowest flow position injection hole 62a from the upstream, The release pressure of the lowest flow position injection hole 62a

by said pulsation can control falling temporarily.

[0040](A 6th embodiment) Although the transfer pipe 60 of a 1st embodiment makes the one transferring part 61 open the one discharge part 62 for free passage and is constituted, as shown in drawing 6, it makes the one transferring part 61 carry out parallel arrangement of two or more discharge parts 62 on a field parallel to the vacuum evaporation side 200a, and comprises this embodiment in the shape of a ctenidium. Since the injection hole 62a can be arranged side by side by this to the 2-way of the direction (longitudinal direction of drawing 6) and the parallel direction of the discharge part 62 where the discharge part 62 is prolonged, the organic metal 100 can be emitted in two dimensions to the vacuum evaporation side 200a, and the homogeneity of the vacuum evaporation to the vacuum evaporation side 200a can be improved.

[0041](A 7th embodiment) As shown in drawing 7, in this embodiment, the crucible 30 is arranged at every one both sides of the glass substrate 200, and the transfer pipe 60 of the shape of a ctenidium of a 6th embodiment is connected with each crucible 30. And the discharge part 62 from both sides is arranged by turns, respectively, and the organic metal 100 in the adjacent discharge part 62 is transported to the direction which counters mutually. Thereby, even if it is a case where the burst size of the injection hole 62a of a downstream part decreases compared with the burst size of the injection hole 62a of an upstream section, the homogeneity of the vacuum evaporation to the vacuum evaporation side 200a is easily securable.

[0042]Since it has the two crucibles 30, if the organic metal 100 is supplied to one crucible 30 and the additive for making the crucible 30 of another side mix into an organic metal is supplied, an additive can be added and, simultaneously with the deposition process of the organic metal 100, it is suitable.

[0043](Other embodiments) It has the attachment component 50 above the discharge part 62, in a 1st embodiment, it forms so that the opening of the injection hole 62a may be turned upward, but it has the attachment component 50 under the discharge part 62, and may be made to form so that the opening of the injection hole 62a may be placed upside down. In the case where this installs a mask member in the vacuum evaporation side 200a, Since a mask member will be installed in the vacuum evaporation side 200a upper part and the necessity of taking into consideration a mask member separating and falling from the glass substrate 200 by gravity is lost, installation to the glass substrate 200 of a mask member can be made easy.

[0044]If it is made to make at least one side rock in the same direction as the parallel direction of two or more discharge parts 62 of a 6th embodiment among the discharge part 62 of a 1st embodiment, and the attachment component 50, the organic metal 100 can be emitted in two dimensions like a 6th embodiment, and it is suitable.

[0045]Although the crucible 30 is arranged in the film forming chamber 20, it may be made to arrange to a way outside the film forming chamber 20 in a 1st embodiment. Since the organic metal 100 can be supplied to the crucible 30 by this, while being able to improve the productivity by an evaporation apparatus, without dividing the film forming chamber 20 and dissolving, much more miniaturization of the film forming chamber 20 can be attained.

[0046]Although the evaporation apparatus of this invention is applied to the resistance heating vacuum deposition which used the sheath heater as a heating method in a 1st embodiment, This invention can be applied also in vacuum evaporation of electron beam evaporation method, high frequency vacuum deposition, laser evaporation, etc., and, of course, it can apply also to the vacuum evaporation at the time of this invention not being restricted to application to vacuum evaporation of an organic metal, but

forming thin films, such as various metal membranes, semiconductor membrane, an insulator film, and a quantity **** body membrane, further.

[Translation done.]